Objective: To describe a technique to refine the nasal tip and supratip while preserving structure; traditional attempts to reduce nasal tip bulbosity involve maneuvers that may result in loss of support, leading to poor functional and cosmetic outcomes.

Methods: A prospective study of patients undergoing open structure nasal tip refinement using scroll joint excision with a septal-lateral crural suture to flatten the lateral crus. Outcomes assessed were nasal peak inspiratory flow (NPIF), nasal obstruction scores, 22-item Sinonasal Outcome Test (SNOT-22), 36-item Short-Form questionnaires (SF-36), and anchor scores for breathing and cosmesis.

Results: The mean NPIF improved from 100 L/min to 139 L/min, nasal obstruction improved, and the mean (SD) SNOT-22 scores improved from 1.45 (0.86) to 0.63 (0.65) (P < .01 for all comparisons). All patients had improved cosmesis, and 2.2% had both subjectively and objectively impaired nasal breathing.

Conclusions: A technique is described allowing refinement of the nasal tip while maintaining or improving the nasal airway and providing a high level of patient satisfaction with the aesthetic outcome. Even in patients seen for cosmetic rhinoplasty, there may be a degree of preoperative nasal obstruction that should be recognized and addressed.

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Rhinoplasty has the potential to compromise the nasal airway. Traditional reductive rhinoplasty has been associated with a relatively high incidence of postoperative nasal obstruction. In particular, excessive trimming of the cephalic margin of the lower lateral cartilage can produce a flail segment and loss of support. This loss of support and subsequent fibrosis results in nasal valve compromise, supra-alar pinching, and alar retraction (Figure 1).1,2

Nasal tip sutures are widely used to modify the shape and position of the domes. Each suture placed has multiple effects, making it challenging to achieve the overall desired shape. Tensional forces from sutures may result in changes over time. Vertical dome division “breaks the spring,” preventing or reducing the development of such forces while allowing maximal cartilage preservation.3 Control over tip shape, projection, and rotation is achieved according to the M-arch model.4,5

Surgical Technique

An open approach is used via mid-columella and marginal incisions. Osteotomies and septoplasty with cartilage harvest are performed, spreader grafts and columella strut are placed, and powered endoscopic turbinoplasty performed. After a stable framework is thereby created. Structural techniques are effective in improving both objective and subjective nasal airflow in patients undergoing functional rhinoplasty for nasal obstruction; however, the functional outcomes for those undergoing cosmetic rhinoplasty are mixed.6-8 This study presents a technique of structured nasal tip refinement with objective and subjective functional outcome results.
ated, the scroll joint is excised from both the upper lateral cartilage (ULC) and the lower lateral cartilage (LLC) without removing any of the cartilage beyond the scroll. This results in the cephalic edge of the lateral crura still meeting or overlapping the caudal edge of the ULCs, maintaining support for the lateral crus and preventing creation of a flail segment (Figure 2 and Figure 3). A septal-lateral crural suture is then placed. This suture has 3 functions: to flatten the lateral crus; to advance and tension the lateral crus if required to prevent external valve collapse; and to fix the cartilage in place, replacing scroll support. This often results in the cephalic edge of the domes becoming prominent above the suture in the supratip area (Figure 2). In most patients, a dome division is then performed with preservation of the vestibular skin. A partial or wedge division is used when the domal height is symmetric. A complete dome division allows more control over nasal tip height when deprojection is required. The medial incision is performed first and is angled from the level of the dorsal septum superiorly toward the desired position of the nasal tip defining point inferiorly. For a partial or wedge dome division, the LLC is not completely transected (Figure 5). The vestibular skin is dissected free of the cartilage, and then the lateral incision is placed so that either a wedge or strip of cartilage is removed. The cartilage is then reapproximated with 6-0 nylon (Figure 6). Some control over rotation is possible by varying the proportion of cartilage removed from the medial and lateral crura. If required, a small tip graft of crushed cartilage or perichondrium is used to soften the contour and increase tip projection.

OUTCOME MEASURES
A combination of subjective and objective outcome measures were used. There is discrepancy between objective measures and quality-of-life (QOL) data, which may measure different aspects of nasal function.\(^9\)\(^\text{10}\)

NPFI MEASUREMENT
Nasal peak inspiratory flow (NPFI) is a noninvasive physiologic measurement of nasal airflow measured in liters per minute. As it measures peak flow, it is particularly sensitive to nasal valve collapse. It has been validated against rhinomanometry and has the advantage of being easier to perform with simple equipment.\(^9\)\(^\text{11}\)\(^\text{13}\) It is performed using a min-Wright peak flow meter with an anesthetic mask. A good seal is ensured, and the patient is instructed to make a maximal inspiratory effort with the mouth closed. The best result of 3 attempts is used.\(^9\)\(^\text{13}\)

SNOT-22 INSTRUMENT
The 22-item Sinonasal Outcome Test (SNOT-22) is a diseasespecific, health-related QOL measure of sinonasal function. The SNOT-20 was developed from the 31-item rhinosinusitis outcome measure (RSOM-31) by removing 11 items thought to be redundant. The readdition of 2 items of interest in rhinosinusitis, nasal obstruction and sense of taste and smell, formed the SNOT-22, which has been shown to be reliable, valid, and responsive.\(^9\)\(^\text{13}\)\(^\text{15}\) Scoring is by taking the mean of the scores, giving a score of 0 to 5. The minimal clinically important difference (MCID) is 0.8.\(^\text{15}\)

NASAL OBSTRUCTION SCORE
Subjective nasal obstruction was assessed using a Likert scale of 0 to 5, with 0 representing no obstruction and 5 as bad as it can be.

SF-36, VERSION 2
The 36-item Short Form Questionnaire, version 2 (SF-36) is a widely used, well-validated general QOL tool used to evaluate health status. It assesses 8 domains that can be grouped to give aggregate mental (MCS) and physical (PCS) scores, which are scaled to a mean (SD) of 50 (10) for the normal population.\(^\text{17}\)\(^\text{18}\) The MCID is 3 to 5 points.\(^\text{19}\)

ANCHOR SCORES
Patients were asked at follow-up to separately rate their changes in nasal function and nasal appearance on a 7-point scale as follows: −3 (significantly worse), −2 (moderately worse), −1 (slightly worse), 0 (no change), 1 (slightly better), 2 (moderately better), and 3 (significantly better).

STATISTICAL ANALYSIS
Statistical analysis was performed with SPSS software (version 17; SPSS Inc, Chicago, Illinois). The SF-36, NPFI, and SNOT-22 scores were normally distributed and treated as parametric data. Obstruction scores were not normally distributed on histogram test and were treated as nonparametric data. Paired sample testing was performed with t test for parametric and Wilcoxon signed rank test for nonparametric data. Subgroup analysis of the effects of dome division was...
performed with independent samples t test and Wilcoxon rank-sum test. Frequency comparisons were made with χ² test or Fisher exact test.

RESULTS

One hundred patients were enrolled into the study. Seventy-five percent were female, and their median age was 31 years (range, 14-68 years). There were 18 revision cases. The mean (SD) duration of follow-up was 8.9 (4.3) months. Eleven patients were lost to follow-up and were excluded from the analysis. Those lost to follow-up were more likely to be male, with better SNOT-22 and SF-36 MCS scores and a trend toward better NPIF scores (Table 1).

NPIF IMPROVEMENT

There was significant improvement in mean NPIF scores (see Table 2 for P values). Overall, the NPIF of 70 patients (79%) improved, the values of 10 (11%) were unchanged, and 9 (10%) experienced decreased NPIF. The NPIF of these patients declined by 10 L/min, which is the measurement limit of the device. The NPIF of 3 patients worsened by 25 to 40 L/min. Of these 3 patients, only 1 had a worse obstruction score. No patients required revision for airway obstruction.

SNOT-22 SCORES

There was a significant improvement in mean (SD) SNOT-22 scores, from 1.45 (0.86) to 0.63 (0.65) (Table 2). The mean change was 0.82, greater than the MCID of 0.8. Overall, 25 patients (28%) experienced an improvement of greater than the MCID, 63 (71%) were within the MCID, and for 1 (1%), the score was worse.
A patient with the worse score had improved SF-36 PCS by 8 points, improved obstruction score (from 5 to 2), and improved NPIF (from 60 to 120 L/min).

Nasal Obstruction Improvement

There was significant improvement in nasal obstruction scores from a median of 3 to 0 (Table 2). Overall, 59 patients (66%) had improved scores, 24 (27%) had unchanged scores, and 6 (7%) had worse scores. Of those with worse obstruction scores, the NPIF was improved in 2, unchanged in 2, and worse in 2.

SF-36 Scores

The SF-36 MCS and PCS scores were significantly improved. However, the mean improvement for both was less than the MCID of 3-5 (Table 2).

Dome Division vs Intact Cartilage Nasal Tip Surgery

There were no significant baseline differences between those who underwent dome division and those who did not. There were significant improvements in SNOT-22 scores, obstruction scores, and NPIF in both groups. However, the NPIF had a significantly greater improvement in the no–dome division group, by a mean (SD) of 47 (51) compared with 35 (34) L/min (P = .02) (Table 3).

Anchor Scores

All patients (100%) rated their appearance as improved, and only 1 patient rated her breathing as worse (Figure 7). This patient had a negative anchor score of −2 (moderate worsening) for breathing and also had a worse nasal obstruction score (it changed from 2 to 3) but had improved NPIF and SNOT-22 scores. In total, only 2 patients had both objective and subjective decline in their nasal airway (2.2%).

Complications and Revision Rates

Seven patients underwent minor cosmetic revisions, such as rasping the nasal dorsum, refracturing the nasal bones, or placement of camouflage grafts for mild irregularities. One patient developed a chronic pseudomonal infection of a spreader graft requiring intravenous antibiotic therapy and removal.

Comment

Inherently, nasal tip refinement and deprojection will lead to some degree of nasal valve narrowing. Loss of nasal valve width occurs with techniques to reduce bulbosity. Height loss occurs with deprojection. To offset these inherent changes, a combination of the valve-modifying techniques described herein allows nasal tip refinement while maintaining or improving the nasal airway and providing high patient satisfaction with cosmetic outcomes (Figures 7, 8, 9, and 10).

In this cohort of patients undergoing cosmetic nasal tip refinement there was a considerable degree of preoperative nasal obstruction, with the mean NPIF score well be-
low the normal range and a median obstruction score of 3. If unrecognized preoperatively and not addressed during surgery, this obstruction may be a cause for postoperative patient dissatisfaction and revision surgery.

Excision of the scroll joint removes one of the major nasal tip support mechanisms of the nose. However, this is also disrupted during cephalic trim or intercartilaginous incisions. Preservation of the full height of the lateral crus allows contact to be maintained between the ULC and lateral crus over the entire length of the ULC, in contrast to a cephalic trim. The septal-lateral crural suture then fixes the lateral crus in place. We believe this combination of scroll reconstruction and LLC tension provided by the suture maintains external valve support to a greater degree than if a cephalic trim is performed with loss of some or all of the contact between ULC and lateral crus.

Dome division was used to refine the nasal tip in most of the patients in this series. Although nasal tip sutures may be used to modify the shape and position of the domes, each suture placed has multiple effects, making it challenging to achieve the overall desired shape, and tensional forces from sutures may result in changes over time. Vertical dome division not only allows precise shap-
ing of the LLC but also “breaks the spring,” preventing or reducing the development of these tensional forces. We believe this technique gives a predictable, aesthetically pleasing shape that is stable over time, and therefore we use dome division (with the other techniques discussed herein) as a first-line maneuver in nasal tip refinement surgery. Both the dome division and no-dome division groups had a significant improvement in their nasal airways, and there was a significantly greater improvement in NPIF in those who did not undergo dome division (Table 3). This may be because patients undergoing dome division are likely to have had a more aggressive nasal tip reduction and therefore are at greater risk of nasal valve compromise, highlighting the potential for causing nasal obstruction in tip refinement surgery. We emphasize the importance of combining tip refinement with other airway maneuvers, including spreader grafts and turbinoplasty. Tip-defining sutures were rarely used without dome division, so comment cannot be made on their possible effects based on this study.

There is good evidence for the efficacy of surgical treatment for nasal valve compromise6; however, prevention is clearly preferable to cure. Constantinides et al8 reported a series of 27 patients undergoing cosmetic rhinoplasty with subjective and objective (plethysmography) assessment. All patients had spreader grafts with cautery and out-fracture of turbinates. In 4 of 10 patients with preoperatively normal nasal resistance, their condition worsened, with 1 becoming symptomatic. Fourteen of 17 patients with preoperatively increased nasal resistance experienced improvement, with 8 patients reclassified into the normal range. Conrad et al7 studied the effect of vertical dome division with or without turbinate cautery and out-fracture in 16 patients, also with plethysmography and symptom scores. In those who were preoperatively normal, airflow was worse in 6 of 8 patients, whereas in those with preoperatively increased resistance, the condition of 2 improved and remained unchanged in 6. Adamson et al20 studied the effects of cosmetic rhinoplasty using rhinomanometry and symptom scores. On objective testing, 10 of 24 patients with preoperatively normal nasal resistance experienced abnormal resistance postoperatively, whereas 12 of 26 with
CONCLUSIONS

Inherently, nasal tip refinement and deprojection will lead to some degree of nasal valve narrowing. We described herein a technique of refinement of the nasal tip, which, in combination with other techniques, results in improvement or maintenance of the nasal airway while providing a high level of patient satisfaction with the aesthetic outcome. Even in patients seen for cosmetic rhinoplasty, there may be a significant degree of postoperative nasal obstruction that should be recognized and addressed.

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Author Contributions: Dr Timperley had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Timperley, Stow, Harvey, and Marcells. Acquisition of data: Timperley, Stow, Srubiski, and Marcells. Analysis and interpretation of data: Timperley, Stow, Harvey, and Marcells. Drafting of the manuscript: Timperley, Srubiski, and Harvey. Critical revision of the manuscript for important intellectual content: Stow, Harvey, and Marcells. Statistical analysis: Timperley, Harvey, and Marcells. Obtained funding: Marcells. Administrative, technical, and material support: Stow, Harvey, and Marcells. Study supervision: Harvey and Marcells.

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REFERENCES


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